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(71)Applicant : TOYOTA MOTOR CORP (72)Inventor : TAKI MASAYOSHI

(54) MANUFACTURE OF AMORPHOUS SUPERLATTICE STRUCTURE

SPECIFICATION

1. Title of the Device: REFLECTIVE REAL-OBJECT-PROJECTOR

2. Claims of Utility Model

1. A reflective real-object-projector comprising:

a light source; a stage, which transmits light radiated from the light source, being capable of mounting an object; a projection mirror for reflecting the light reflected from the object; and a projection lens for condensing the light reflected from the projection mirror and forming a projection image of the object on an external screen,

wherein the projection mirror is provided with reflective mirrors individually at both sides of the projection mirror, the reflective mirrors reflecting the light from the light source so as to apply the light to the object through the stage; and

wherein the light source is positioned in front of the projection mirror and between the reflective mirrors such that regularly reflected light from the object and the stage, the regularly reflected light being produced of the light reflected by the reflective mirrors, is not applied to the projection lens, and that the real image and the virtual image of the light source are disposed outside the field angle of the projection lens.

2. A reflective real-object-projector according to Claim 1, wherein the reflective mirrors are disposed parallel to each other and perpendicular to the stage.

3. A reflective real-object-projector according to one of Claims 1 and 2, wherein a light-shielding member for shielding the projection mirror from the direct light of the light source is provided around the light source at the projection mirror side.

4. A reflective real-object-projector according to one of Claims 1 to 3, wherein air which is taken from the outside by a cooling fan flows along an inner side of the stage and is discharged from the vicinity of the light source.

3. Detailed Description of the Device

(Industrial field of the device)

The present device relates to reflective real-object-projectors, in particular, to a method for irradiating an object in a reflective real-object-projector, in which the object such as a manuscript copy is irradiated by a light source via reflective mirrors, and the light irregularly reflected is imaged on a screen via a projection mirror and a projection lens.

(Related art)

Hitherto, a type of the real object projector is known, in which, generally, an object placed on a stage 11 made of glass or the like is irradiated directly by light sources 12, as shown in Fig. 7. In the drawing, numeral 13 denotes a projection mirror which reflects the light reflected from the object, numeral 14 denotes a projection lens, and numeral 15 denotes a casing.

In the method for irradiating the object by using this projector,

firstly, deterioration of the resolution of a projection image due to regularly reflected light from the object and the stage 11 must be avoided by positioning the light sources 12 in such a manner that the light regularly reflected by the object and the stage 11 according to the law of reflection, the regularly reflected light being produced of the light radiated by the light sources 12, is not applied to the projection lens 14 via the projection mirror 13. Secondly, the positions of the light sources 12 must be set so that each light source 12 is not positioned within the field angle of the projection lens 14. Thirdly, each light source must be positioned at a considerable distance from the stage 11 in order to evenly illuminate the stage 11. However, since the length of light path is limited practically due to the restriction of the size and the like of the projector, a plurality of the light sources 12 each having a limited number of light fluxes are used for illuminating the stage 11 from the sides thereof..

In consideration of the above, an illumination method is used for the projector shown in Fig. 7, in which a plurality of the light sources 12 are positioned below both sides of the stage 11 at proper distances from the stage 11 such that proper irradiation angles are maintained by considering the size of the stage 11, the field angle of the projection lens 14, and the like.

However, when the light sources 12 are disposed at greater distances from the stage 11 in order to illuminate more evenly, a problem occurs in that the width and the height of the projector are inevitably increased and the weight thereof increases because the number

of light sources is increased, whereby the cost of the projector increases, the configuration thereof is made complex, and the transportation and installation of the projector cannot be performed easily. There has been also a problem in that when the light sources 12 are disposed close to the stage 11 so as to reduce the size of the projector, variations in the intensity of illumination over the object occur.

A reflective real-object-projector has been proposed in consideration of the above problems in, for example, Japanese Unexamined Utility Model Publication No. 61-11148, in which the light sources 12 are positioned at the front face of the projector so as to oppose the projection mirror 13, as shown in Fig. 8, and the light from the light sources 12 is radiated to the object disposed on the stage 11 by reflecting the light at the projection mirror 13, principally in order to reduce the size of the projector and suppress the variations in the intensity of illumination.

Another reflective real-object-projector has been proposed in, for example, Japanese Unexamined Utility Model Publication No. 61-16544, in which a plurality of irradiation mirrors 16 expanded upward and forward are provided around the projection mirror 13, as shown in Fig. 9, for evenly illuminating the object and improving illumination efficiency, whereby the light radiated by the light sources 12 is reflected toward the stage 11 by using the irradiation mirrors 16 and the projection mirror 13.

(Problems to be Solved by the Device)

In the real object projector shown in Fig. 8, the light sources 12 are disposed in positions opposing the projection mirror 13, and the light from the light sources 12 is reflected by the projection mirror 13 and is applied to the stage 11 and the object in a substantially vertical direction. In this case, the regularly reflected light (specular reflection light) from the irradiated object and the like is reflected in a substantially vertical direction in accordance with the law of reflection and is applied to the projection lens 14 via the projection mirror 13, the regularly reflected light deteriorating the resolution of a projection image and causing so-called halation.

In the real object projector shown in Fig. 9, the projection mirror 13 and a plurality of the irradiation mirrors 16 provided independently from the projection mirror 13 serve to apply all the light from the light sources 12 in a direction toward the stage 11 so as to improve the illumination efficiency. Therefore, the irradiation mirrors 16 as a unit must be polyhedral in order to avoid the regularly reflected light produced in accordance with the law of reflection being applied to the projection mirror 13, whereby a problem occurs in that the structure of the projector is made complex. Since the projection mirror 13 is also used as an irradiation mirror, the light sources 12 must be positioned at both sides of the projection mirror 13 such that a part of the light radiated by the light sources 12 is applied to the projection mirror 13. Therefore, there has been a drawback in that the size of the projection is increased in a horizontal direction (in the width direction of the projection mirror 13) in addition to the drawback in that the

irradiation mirrors 16 are made complex.

Accordingly, an object of the present device is to provide a reflective real-object-projector in which the halation of a projection image can be avoided, the light path from a light source to a stage can be elongated for uniform illumination, the size and the weight of the projector can be reduced, and the configuration thereof can be made simple by disposing the light source between reflective mirrors, which are disposed at both sides of the stage, and in front of a projection mirror such that the regularly reflected light from the object and the stage via the reflective mirrors is not applied to the projection lens, and a real image and a virtual image are positioned outside the field angle of the projection lens.

(Means to Solve the Problems)

To these ends, according to the present device, a projection mirror is provided with reflective mirrors in front of and individually at both sides of the projection mirror, the reflective mirrors reflecting light radiated from a light source so as to apply the light to an object disposed on a stage. The light source is positioned in front of the projection mirror and between the reflective mirrors such that regularly reflected light from the object and the stage, the regularly reflected light being produced of the light reflected by the reflective mirrors, is not applied to a projection lens, and that the real image and the virtual image of the light source are disposed outside the field angle of the projection lens.

In the reflective real-object-projector according to the present

device, the reflective mirrors are preferably disposed parallel to each other and perpendicular to the stage. When the light source is disposed in front of and in the widthwise inside of the projection mirror, a light-shielding member for shielding the projection mirror from the direct light of the light source is preferably provided around the light source at the projection mirror side. In order to cool the projector from the inside thereof, air which is taken from the outside by a cooling fan preferably flows along the inner side of the stage and is preferably discharged from the vicinity of the light source.

(Operation)

According to the present device, since the reflective mirrors are provided in front of and individually at both sides of the projection mirror and the light source is positioned as described above, radiating light from the object and the stage regularly reflected by the reflective mirrors is not applied either via the projection mirror or directly to the projection lens. Direct light from the real image and the virtual image of the light source is not either applied to the projection lens. That is, only the light which is irregularly reflected at the object and the stage and is reflected by the projection mirror is applied to the projection lens, thereby preventing a projection image from halation.

Since the light source is positioned such that the light generated by the light source and reflected by the reflective mirrors irradiates the stage, the stage is irradiated by the virtual image of the light source disposed at the outer side of each reflective mirror, whereby the

length of each light path can be made sufficiently large although the light source is disposed inside the projector. Therefore, uniform illumination can be made possible even when light sources are not provided under the stage at both sides thereof or when the number of light sources is relatively small.

Moreover, the projector can be reduced in size by providing the light source between the reflective mirrors. In particular, when the reflective mirrors are disposed parallel to each other and perpendicular to the stage, the configuration can be made simple and all the components of the real object projector can be received in a narrow rectangular parallelepiped space, whereby the configuration of the projector can be made simple and the size of the projector can be reduced.

The light-shielding member mounted to the light source serves to prevent the light of the light source from irradiating the object and the stage either directly or via the projection mirror and the light regularly reflected by the object and the stage from being applied to the projection lens via the projection mirror. The cooling means for cooling sequentially the stage and the light source cools the projector efficiently from the inside thereof so as to prevent temperature inside the projector from rising.

(Embodiments)

An embodiment according to the present device is described below with reference to the drawings. Figs. 1 to 4 show a first embodiment according to the present device. In Figs. 1 and 2, numeral 1 denotes a

rectangular parallelepiped casing. Reflective mirrors 2A and 2B are individually disposed at the inner sides of two side plates of the casing 1 toward the front ends of the side plates such that the reflective mirrors 2A and 2B oppose each other. The reflective mirrors 2A and 2B may be each formed so as to have substantially the same length as that of each side plate. A stage 3, which transmits light reflected by the reflective mirrors 2A and 2B, is provided at an upper surface of the casing 1. The reflective mirrors 2A and 2B are each perpendicular to the stage 3. The stage 3 is made of glass and has a given size so as to mount thereon an object (not shown) such as a three dimensional substance which has a certain thickness or a manuscript copy to be projected.

A projection mirror 4 for receiving the light reflected by the object disposed on the stage 3 is provided in the casing 1. The projection mirror 4 is inclined by approximately 45° with respect to the horizontal plane, as shown in Figs. 1 and 2(c). The projection mirror 4 is formed substantially as a trapezoid. The longer bottom side of the projection mirror 4 is disposed in the vicinity of a side member of the stage 3. A projection lens 5 for condensing the light reflected from the projection mirror 4 is provided at the front face of the casing 1.

Light sources 6A and 6B, which are tungsten halogen lamps or the like, are provided in the casing 1 in front of the projection mirror 4 and between the reflective mirrors 2A and 2B. The light sources 6A and 6B are disposed so that the center of the optical axis of each of the light sources 6A and 6B is directed toward the inner side of the

reflective mirror 2A or 2B. That is, since the light reflected by the reflective mirrors 2A and 2B must irradiate the overall region of the stage 3, the light sources 6A and 6B are disposed toward the front sides of the centers of the reflective mirrors 2A and 2B, respectively, such that the light sources 6A and 6B upward illuminate the reflective mirrors 2A and 2B, respectively, as shown in Figs. 1, 2(a), and 2(b).

A more important condition is that the light sources 6A and 6B must be disposed at positions at which the light, which is applied to the object and the stage 3 via the reflective mirrors 2A and 2B and is regularly reflected by the object and the stage 3 in accordance with the law of reflection, is not applied to the projection lens 5 either directly or via the projection mirror 4. The light sources 6A and 6B are positioned such that the light sources 6A and 6B (the real images of the light sources 6A and 6B) and the virtual images 6a and 6b of the light sources 6A and 6B, shown in Figs. 1, 2(a), and 2(b), are disposed outside the field angle of the projection lens 5. That is, the light sources 6A and 6B are positioned such that only a part of the radiating light, which has passed via the reflective mirrors 2A and 2B, has irregularly reflected by the object and the stage 3, and has reflected by the projection mirror 4, is applied to the projection lens 5.

As long as the above-described conditions are satisfied, the positions of the light sources 6A and 6B are not limited to those shown in Figs. 1 and 2, and the light sources 6A and 6B may be disposed in front of the projection mirror 4 and closer to each other at a widthwise intermediate part of the projection mirror 4. The light sources 6A and

6B may be positioned, for example, as shown in Fig. 3. In this case, there is a risk in that the direct light from the light sources 6A and 6B is reflected by the projection mirror 4 and irradiates the stage 3 and the object in a vertical direction, and the light regularly reflected from the stage 3 and the object substantially in a vertical direction is applied to the projection lens 5 via the projection mirror 4. In order to avoid the risk, light-shielding members 7A and 7B, which appropriately cover around the light sources 6A and 6B, respectively, at the sides thereof toward the projection mirror 4, are provided such that the projection mirror 4 is positioned between critical lines L_1 and L_2 of the direct light which are determined according to the relationship of positions between the light sources 6A and 6B and the light-shielding members 7A and 7B, respectively.

The operation is described below. As shown in Figs. 1, 2(a) and 2(b), the light from the light sources 6A and 6B is reflected by the reflective mirrors 2A and 2B, respectively, and obliquely upward irradiates the overall stage 3. In this case, the stage 3 is illuminated upward from the right and left sides of the stage 3 by the virtual images 6a and 6b via the reflective mirrors 2A and 2B, respectively, the virtual images 6a and 6b being disposed outside the reflective mirrors 2A and 2B, respectively, whereby the respective light paths from the stage 3 to the virtual images 6a and 6b can be ensured sufficiently long, thereby substantially evenly illuminating the overall stage 3. Therefore, the intensity of the light reflected by the object mounted on the stage 3 is also made uniform. The reflected light is

reflected by the projection mirror 4, is condensed by the projection lens 5, and is imaged on an external screen disposed at a distance determined by the focal distance of the projection lens 5.

As described above, the light sources 6A and 6B, the reflective mirrors 2A and 2B, and the projection mirror 4 are positioned such that the regularly reflected light from the object and the stage 3 is not applied to the projection lens 5 either directly or indirectly via the projection mirror 4, and the direct light from the real images and the virtual images of the light sources 6A and 6B is not applied to the projection lens 5, thereby completely avoiding the phenomenon of halation in that the resolution of the projector is deteriorated by the regularly reflected light or the direct light.

As described above, the regularly reflected light and the direct light can be prevented from being applied to the projection mirror 4 and the long light paths can be ensured, by disposing the light sources 6A and 6B in front of the projection mirror 4 and between the reflective mirrors 2A and 2B and by using the light-shielding members 7A and 7B, as needed. Therefore, the width (the size in a direction perpendicular to the surfaces of the reflective mirrors 2A and 2B) of the real object projector can be reduced. Theoretically, the width of the real object projector can be reduced to the width of the stage 3. The components of the real object projector can be received in a rectangular parallelepiped space, whereby the configuration of the projector can be simplified and the size thereof can be further reduced.

In a real object projector of this type, the light sources 6A and

6B generates heat of an elevated temperature and the temperature inside the casing 1 rises to a considerably high level, whereby there is a risk of causing damages to the components of the projector and the object placed on the stage 3. Therefore, the inside of the casing 1 is forcibly cooled. A method for cooling in the above-described embodiment is described below.

Fig. 4 shows the internal configuration of the real object projector shown in Fig. 2(c). In the drawing, numeral 8 denotes a cooling fan disposed below the projection mirror 4, numeral 9 denotes vents disposed above the projection lens 5, and numeral 10 denotes vents disposed below the light sources 6A and 6B. With this arrangement, air introduced by the cooling fan 8 into the casing 1 reaches an upper part of the casing 1 along the backside of the projection mirror 4 and moves forward along the inner surface of the stage 3, as shown in Fig. 4, whereby the stage 3 is cooled directly and efficiently, thereby avoiding a risk of high-temperature heat which causes damages to the object such as a manuscript copy.

A part of the air is discharged through the vents 9 after cooling the stage 3, and the remaining air passes by the light sources 6A and 6B and is discharged through the lower vents 10. Since the light sources 6A and 6B are also cooled in this operation, the risk of an elevated temperature inside the casing 1 is avoided.

An appropriate casing (not shown) may enclose the light sources 6A and 6B so as not to interrupt the radiating light from the light sources 6A and 6B, whereby heat radiation from the light sources 6A and 6B is

reduced; therefore, cooling can be more effectively performed. The casing may be formed capable of being used also as the light-shielding members 7A and 7B. When heat-wave-transmissible mirrors are used as the reflective mirrors 2A and 2B, the temperature rise in the stage 3 can be suppressed more effectively.

Figs. 5 and 6 show second and third embodiments, respectively, according to the present device. In these embodiments, illumination which is brighter and evenner than that in the first embodiment is realized by using pluralities of light sources disposed at the respective sides of the projection lens 5.

That is, in the embodiment shown in Fig. 5, light sources $6A_1$ and $6A_2$ and light sources $6B_1$ and $6B_2$ are disposed at the respective sides of the projection lens 5 along the axis thereof. In this case, the central line of the optical axis of each light source is not parallel to the central line of the optical axis of the adjacent light source so that the incident angle of the radiating light from the light source to the reflective mirror 2A or 2B slightly differs from the incident angle of the radiating light from the adjacent light source such that the stage 3 can be illuminated evenly regardless of the variations in positions between the light sources $6A_1$ and $6A_2$ and between the light sources $6B_1$ and $6B_2$. In the embodiment shown in Fig. 6, the light sources $6A_1$ and $6A_2$ and the light sources $6B_1$ and $6B_2$ are disposed at the respective sides of the projection lens 5 in a direction perpendicular to the axis thereof (in the height direction of the projector). The central lines of the optical axes of the light sources $6A_1$ and $6A_2$ are not parallel to

each other and the central lines of the optical axes of the light sources $6B_1$ and $6B_2$ are not parallel to each other so that the stage 3 is evenly illuminated.

The light sources $6A_1$ and $6A_2$ and the light sources $6B_1$ and $6B_2$ according to the second or third embodiment are disposed such that the light reflected from the reflective mirrors 2A and 2B can irradiate the object through the stage 3, the regularly reflected light from the object and the stage 3 is not applied to the projection lens 5 either indirectly or directly, and the real images and the virtual images of the light sources $6A_1$, $6A_2$, $6B_1$, and $6B_2$ are disposed outside the field angle of the projection lens 5 in the same manner as in the first embodiment. The light-shielding members 7A and 7B shown in Fig. 3 are preferably mounted to the light sources $6A_1$ and $6A_2$ and the light sources $6B_1$ and $6B_2$, respectively, and the cooling method shown in Fig. 4 is preferably used, as needed.

The number of light sources is not limited to that described in the above embodiments, and the number may be increased.

(Advantages of the Device)

According to the present device described above, reflective mirrors are provided in front of and individually at both sides of the projection mirror, and light sources are provided in front of the projection mirror and between the reflective mirrors, such that the regularly reflected light from the object and the stage, the regularly reflected light being produced of the light reflected by the reflective mirrors, is not applied to the projection lens and the real images and

the virtual images of the light sources are positioned outside the field angle of the projection lens. With this arrangement, the following advantages are provided.

Firstly, since the regularly reflected light and the direct light of the light sources are not applied to the projection lens and only the irregularly reflected light from the object and the stage reflected by the projection mirror is applied to the projection lens, the projector does not produce halation; therefore, it forms a high-resolution image.

Secondly, since the light sources are provided between the reflective mirrors and the virtual images of the light sources which illuminate the stage are disposed outside the projector, sufficiently long light paths can be ensured although the actual light sources are disposed inside the projector, thereby realizing uniform illumination. In other words, since it is not necessary to provide the light sources significantly away from the stage or to provide numerous light sources, the weight and the manufacturing costs of the projector can be reduced and the configuration of the projector can be simplified because the size of the projector and the number of light sources are reduced, whereby a real object projector easy to transport and to install is obtainable.

Thirdly, since the light sources are provided between the reflective mirrors, the size of the projector can be further reduced, and the width thereof can be reduced to the width of the stage at a maximum.

Fourthly, since the shape, the configuration, and the like of the

reflective mirrors may be simple compared with those of the known polyhedral radiation-mirrors, a risk in that the internal configuration becomes complex can be avoided, and all the components of the real object projector can be received in a narrow parallelepiped space, whereby the configuration of the projector can be simplified.

4. Brief Description of the Drawings

Figs. 1 to 4 show a first embodiment according to the present device. Fig. 1 is a perspective view of an internal configuration. Fig. 2(a) is a plan view of the same. Fig. 2(b) is a front view of the same. Fig. 2(c) is a side view of the same. Fig. 3 is a plan view of a modified example of the first embodiment. Fig. 4 is a side view showing a method for cooling the inside. Fig. 5 shows a second embodiment according to the present device. Fig. 5(a) is a plan view of an internal configuration. Fig. 5(b) is a front view of the same. Fig. 6 shows a third embodiment of the present device. Fig. 6(a) is a plan view of an internal configuration. Fig. 6(b) is a front view of the same. Figs. 7 to 9 are perspective views each showing a known example.

1 ... casing

2A and 2B ... reflective mirrors

3 ... stage

4 ... projection mirror

5 ... projection lens

6A, 6A₁, 6A₂, 6B, 6B₁, and 6B₂ ... light sources

6a and 6b ... virtual images

7A and 7B ... light-shielding members

8 ... cooling fan

9 and 10 ... vents

Applicant for utility model registration: Plus Corporation

Representative: Yuichi Morita, Patent Attorney

Fig. 1

1: casing

2A and 2B: reflective mirrors

3: stage

4: projection mirror

5: projection lens

6A and 6B: light sources

6a and 6b: virtual images

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9